

Stabilization of Gravel and Stone Streets and Repairs of Street Cuts for Utility Companies

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Our methods as now used have been in the process of development over the four-year period just past, and it will be necessary to go back and review this period in order to give you a true picture of this development.

Coming into office in 1943, we found that all street maintenance had been carried on under the supervision of the street commissioner. The only equipment available consisted of three trucks, a patrol grader, and a street flusher. A small appropriation had been set up to cover purchases of patching material from a local asphalt plant, probably with the idea of resurfacing some old brick streets. During the season of 1943, because of the scarcity of asphaltic materials, little was done toward stabilizing or repair of gravel or cinder streets, but a lot of patching was done on our downtown, sheet-asphalt, resurfaced streets and considerable money was spent in building up our equipment. We were able to contract the services of a small portable plant for mixing our patch material, which was bituminous coated aggregate using state specifications. Asphalt emulsions were available and were used in the mixture. For shallow patches, No. 12 crushed boulders were used as the aggregate and produced excellent results.

In preparing the budget for 1944, a sizeable sum having accrued in the gasoline tax receipts, a much larger appropriation was set up for street maintenance.

MATERIALS AND METHODS

All street maintenance was transferred to the engineering department and an organization was set up for this work. During the winter a survey was made of close-in gravel streets, having a fair gravel base, which might be stabilized. In March, bids were received on aggregate at the plant and bituminous materials mixed-in-place. The low bid was

for the use of asphalt emulsion by the contractor doing our work the previous season.

Work proceeded in the usual manner of stabilization by loosening the old material to a depth of 4", reshaping, addition of new gravel where needed, priming the base, and mixing in the required amount of AES-3 by windrowing and blading to produce a well-stabilized base. The surface was then sealed, first with a covering of pea gravel and then with a sand seal.

Exceptionally good results were obtained, but the work was slow and expensive with the equipment available, and we were using an excessive amount of asphalt when it was difficult to obtain.

With a mixing plant available and the contractor agreeing to pre-mix the material at the same price as mixing-in-place on the street, we decided to plant-mix our stabilizing material, using state specification for No. 6 graded gravel. By using approximately 10 gallons of AES-3 per ton of aggregate we produced a very desirable mixture which, as tests showed later, contained approximately 3.2 percent of bitumen. By spreading this mixture with a blade on a prepared base to an average 2" thickness, we secured a very desirable surface; it was, however, quite open and required a double seal to prevent raveling.

We were at first troubled considerably by wet gravel, but the contractor was able to secure a dryer. By paying the contractor an additional fee, we were able to dry the aggregate sufficiently to remove all surface moisture before coating. This gave us a much better mixture, which spread much more easily and could be rolled and placed in service more quickly than our previous mixes.

A great deal of work done during the season of 1944 was on streets where there were no curbs and where drainage was poor. The winter of 1944-1945 was severe, and in the spring we had some failures due to side-street parking off the surface but mostly from thin spots in the surface due to uneven spreading with a blade.

In preparing our plans for the 1945 season we set up a very sizeable budget for this class of work. From our experiences during the previous season we wrote a complete new set of specifications changing the gradation of the aggregate to secure a denser surface, requiring the aggregate to be heated to higher temperatures, and requiring the use of a mechanical spreader for placing the mixture.

In arranging our program for the season, we confined most of our work to streets having curbs. Contracts were let as before, the city furnishing the aggregate to the plant and delivering the mixture to the

job. The contractor heated, mixed, and placed the material on a base previously prepared by the city, at a unit price per gallon.

On most of the streets on which work was to be done, gravel had been applied over a long period until the surface usually was raised to the level or, in many cases, above the top of the curb. This caused us to do considerable grading in preparing the base; and in most cases very little, if any, of the old gravel base remained. It was necessary for us to thoroughly compact the old surface by rolling before application of the mixture. Any weak spots were removed and backfilled with material taken from the street. On this surface, we spread the mixture to get a uniform 3" compacted thickness.

By keeping the temperature of the aggregate at approximately 200° F. on entering the pug-mill mixer, we had a mixture that handled easily and an emulsion which had taken its initial break before reaching the spreader so that the surface could be rolled immediately. Traffic was never stopped during construction.

While we felt we had achieved a much denser surface, we did make doubly sure by sealing with a light sand seal using .25 gallon of asphalt emulsion AE-150 and approximately 10 pounds of torpedo sand per square yard of surface.

While this work is only a little over a year old, it has gone through one very severe winter without any signs of failure. The surface has become smooth and easy-riding, and a number of the streets thus surfaced are carrying extremely heavy traffic.

PATCHING

We also found this material ideal for patching either deep or shallow holes. We have filled holes 6" to 8" deep, and no mush or shoving has developed. As a consequence, we rigged up a concrete mixer for mixing winter patches.

The announcement that we would not improve streets without curbs brought a deluge of petitions for curb and sidewalks. Inasmuch as establishing new grade lines caused considerable grading, we insisted that this also be included in the petitions. In most instances the Board of Public Works granted the petitions and passed improvement resolutions.

In mixing winter patching material in the concrete mixer, we had been using a blowtorch inside the mixer to heat the aggregate and applying the emulsion at the same time. We found that the product we turned out was even better than what we had been putting through the mixing plant. The aggregate was perfectly coated, with no apparent

harm to the asphalt from burning. The mixture could be transported in a workable condition, even in extreme cold, and immediately put into service.

In Anderson we have miles of sheet asphalt resurfacing over old brick. This surface is not well bonded to the brick, and is hard and brittle. Moisture freezing between the surface and base loosens large areas of the surface so that patching is a constant process.

To meet this emergency we experimented a little further with our concrete mixer in producing a hot sand mixture using asphalt emulsion AE-150. By trying various gradations of sand we finally obtained a mixture with which we were satisfied. Measurements were made by volume, and theoretically we had a mixture containing 6 to 6.5 percent bitumen. Anxious to test our results, we made patches under extreme weather conditions. The results were far better than anything we had ever had before, the material blending into the old surface so that the patch was scarcely noticeable.

Of course we were still doubtful as to what might happen when the material was subjected to extreme summer heat. Unseasonably warm weather in March with temperatures in the 80's gave us a partial answer. None of the patches softened up, mushed, or shoved. By this time we were pretty well sold on our product.

We made little change in our 1946 specifications except to increase the fines.

A NEW METHOD

Not until we had a good start on the season's work were we able to sell the contractor on the idea of equipping his plant to mix the material in the dryer, which, by the way, was a new one and of larger capacity. Our ideas were contrary to all texts on and previous uses of emulsions. However, the results from our own patching materials finally convinced him.

Experiments on the proper point of applying the emulsion in the dryer had to be conducted, and heat controls had to be established according to the water content in the gravel.

The product, after these adjustments had been made, came from the dryer a perfectly coated material which would not peel on the immediate application of water or from handling. Results on the street have proved equally satisfactory. The pavement can be rolled immediately behind the spreader to produce a surface sufficiently tight to eliminate sealing.

Several miles of this type of surface were laid during the 1946 season. The thickness of the surface was varied from 3" to 6" in accordance with the weight of traffic anticipated.

Also during the season we surfaced several old asphalt macadam and concrete streets with our asphalt-sand mixture manufactured in the same manner.

For experimental purposes we first chose a broken-down, concrete-surfaced street which was an outlet for extremely heavy traffic of all kinds. A leveling course of bituminous-coated aggregate binder was first applied, and over this the sand mixture was placed at approximately 100 pounds per square yard. This application was made during July.

Our worst fears were soon removed. The surface remained smooth and hard under the traffic to which it was subjected, and now bears every resemblance to a rock-asphalt surface because the silica sand gives it the sheen of rock asphalt.

COSTS

Accurate costs are kept on all work, allowing \$2.00 per hour for equipment, \$1.25 for operators, and \$1.00 for common labor which is furnished by the city. Other costs are from the unit price bid.

Following are the costs of a new improvement containing 6,267 square yards of surface. Curbs and gutters had been constructed and the grading done by assessment.

Excavation (paid by property frontage).....	\$.24 per sq. yd.
Base preparation by city.....	.16 per sq. yd.
1808.4 tons stabilized base mixture in place.....	.97 per sq. yd.

Total cost of improvement.....\$ 1.37 per sq. yd.

Inasmuch as this street carries considerable heavy traffic, 520 pounds of stabilized mixture per square yard was used in the construction.

Another example where the city carried all the expense is as follows:

Medium grading and base preparation.....	\$.106 per sq. yd.
639.3 tons of stabilized base mixture in place....	.702 per sq. yd.

Total cost of improvement.....\$.808 per sq. yd.

This job contained 4,400 square yards, and the thickness of the surface averaged 2.9 inches compacted.

I have chosen these two examples as being representative of minimum and maximum costs of the work done during the 1946 season. Our costs

for placing the asphalt-sand mixture at 100 pounds per square yard averaged \$.37 per sq. yd. in place.

During the 1946 season we surfaced 1.8 miles of alleys and 7.5 miles of streets. The average width of alley surfaced was 12 feet and the average width of street surfaced was 30 feet.

REPAIRING UTILITY CUTS

Each year we have let a contract covering our concrete repairs to curbs, sidewalks, and street patches. This contract also covers relaying brick. We use this contract in making repairs to streets where the various utilities have made cuts or trenches. These repairs are all made and measured by the engineering department, and a copy of the estimate is furnished to the contractor and the utility making the cut. The contractor in turn bills the utility direct in the amount of the estimate. If the cut is in a concrete pavement, it is replaced and finished as before. If the cut is in a brick surface, a five-inch slab is poured over the cut or trench and the brick relaid. If the cut is in an asphaltic surface, either on concrete or brick base, a slab is poured flush with the subbase by the contractor, and the city patching crew replaces the asphalt surface.

On trenches cut by plumbers in making a repair or new installations, we have followed a different procedure. Permits to cut into the street are issued only to licensed plumbers who have posted a bond with the city. At the time of taking out the permit, which is issued by the city engineer, the plumber pays a fixed charge, depending on the type of pavement in which the cut is made. This payment is made to the controller and goes into the general fund. This charge has been figured to cover the average cost of making a repair extending from the center of the street to the property line. If the repair is larger than this, an additional charge is made at the rate of \$4.00 per sq. yd. The plumber is required to backfill his trench and maintain it until he is reasonably sure there will be no further settling. The city then makes the pavement repairs.